Staffing Concerns Regarding ARFF Apparatus

EXECUTIVE LEADERSHIP

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ABSTRACT

Patrick Air Force Base (PAFB), like all military installations, had experienced a large reduction in force over the last several years. The fire department at PAFB was not spared during this reduction. While three to four personnel was once considered normal staffing of Airport Rescue and Fire Fighting (ARFF) apparatus, this number had dwindled down to what was then two.

The problem is there are no known guidelines to determine adequate staffing levels for ARFF apparatus. As a result, staffing had been significantly reduced to meet reduction goals.

The purpose of this research project was to determine if a need for nationally accepted guidelines exist. An evaluative research procedure was used to determine this possibility.
The following research questions were addressed:

1. Are there nationally recognized standards which assist in staffing decisions of ARFF apparatus?
2. What are the trends among airport fire departments regarding the staffing of ARFF apparatus?
3. Are airport fire departments staffed in such a manner as to efficiently deploy hoselines during an aircraft incident?
4. Do airport executive fire officers feel they are adequately staffed to effectively mitigate an aircraft accident?

5. Would airport executive fire officers be in favor of nationally recognized staffing recommendations and/or requirements?

The procedure required a literature review on the subject and a survey instrument of a broad spectrum of airport fire departments across the country.

The literature review found while all sources agreed some type of ARFF protection was required, there was quite a bit of interpretation as to adequate resources (to include staffing) needed to accomplish this task.

The survey instrument found most respondents feel their respective departments were not adequately staffed to effectively mitigate an aircraft accident. Additionally, most respondents were in favor of the establishment of nationally recognized staffing recommendations and/or guidelines.

This report recommended staffing requirements be established by the Federal Aviation Administration. It also recommended staffing guidelines be established by the National Fire Protection Association. Finally, the report recommended to conduct additional research as to track the progress of implementing staffing guidelines and/or regulations. Specifically, monitor the impact of recommended and/or required staffing in regards to survival rates.

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INTRODUCTION

Patrick Air Force Base (PAFB), like all military installations has experienced a large reduction in force over the last several years.

The problem is there were no known guidelines to determine adequate staffing levels for Airport Rescue and Fire Fighting (ARFF) apparatus. As a result, staffing had been significantly reduced to meet reduction goals.

The purpose of this research project was to determine if a need for nationally accepted staffing guidelines existed.

An evaluative procedure was used to research this problem. Research information was obtained at the Learning Resource Center (LRC) located at the National Emergency Training Center (NETC), and the PAFB Fire Department. In addition, a survey instrument was sent to one hundred airport fire departments across the country.

The following research questions were answered using the evaluative research procedure:

1. Are there nationally recognized standards which assist in staffing decisions of ARFF apparatus?

2. What are the trends among airport fire departments regarding the staffing of ARFF apparatus?
3. Are airport fire departments staffed in such a manner as to efficiently deploy hoselines during an aircraft incident?
4. Do airport executive fire officers feel they are adequately staffed to effectively mitigate an aircraft accident?
5. Would airport executive fire officers be in favor of nationally recognized staffing recommendations and/or requirements?

BACKGROUND AND SIGNIFICANCE

Patrick AFB is located just south of Cocoa Beach on the east coast of central Florida. Originally known as the Banana River Naval Station, the base was used for amongst other things, submarine patrol during WW II.

The PAFB Fire Department provides fire protection services to an area of approximately 3.3 square miles with a daytime population of approximately 5,500 personnel.

In addition to the structural fire protection provided, the PAFB fire department is responsible for ARFF protection for the assigned, tenant, and transient aircraft. The size of these aircraft range from the small civil air patrol Cessna's, to the huge C-5 Galaxy which is capable of transporting thousands of pounds of cargo as well as hundreds of passengers. To accomplish this the fire department has 59 personnel assigned; operating out of one fire station. A second fire

station in the south housing area was closed about three years prior to this report due to budget constraints.

Along with the closure of the second fire station, PAFB fire department had seen a significant reduction of force over the last several years. While three or four personnel was once considered normal staffing of ARFF apparatus, this number dwindled to what now is two.

This research project was relevant to the Managing Change Unit of the National Fire Academy's Executive Leadership Course in that it was attempting to proactively deal with decreasing staffing levels.

LITERATURE REVIEW

A literature review was conducted in order to gain relevant information regarding staffing of ARFF apparatus. Several significant contributions were found at the LRC located at the NETC and the PAFB Fire Department.

Statistics show that approximately 80 percent of all major aircraft accidents occur in the critical rescue and fire fighting access area of the airport. This is the primary response area for airport based ARFF services. Approximately 15 percent of the accidents occur in the approach areas. (National Fire Protection Association [NFPA] 402, 1996). Mr. Leroy H. Wilcox, Senior Advisor for AON Risk Services (one of the largest aviation brokerage companies in the world) concurs with this fact. In a personal interview with Mr. Charles Brush of the Lebanon Fire

Department, Mr. Wilcox relates in general about 80 percent of crashes occur during landing or take off. "When they (aircraft) are at cruising altitude for the most part, they can handle most situations" (Brush, 1997, p 6).

The essence of time and the need for quick intervention when an aircraft accident occurs is stressed by the NFPA.

> The survivable atmosphere inside an aircraft fuselage involved in an exterior fuel fire is limited to approximately three minutes if the integrity of the airframe is maintained during the impact. When the aluminum skin is directly exposed to flame, burnthrough will occur within 60 seconds or less while the windows and insulation may withstand penetration for up to three minutes. Because of this serious life hazard to occupants, rapid fire control is critical. Therefore, whenever flight operations are in progress, ARFF vehicles and personnel shall be so located that optimum response and fire control can be achieved within this time frame (NFPA 402, 1996, p 402-11).

The Federal Aviation Administration (FAA) recognizes the distinct possibility of an accident occurring on an airport and therefore publishes regulations regarding ARFF response. While staffing is not specifically addressed, the agent requirements and time standards are spelled out according to the size of the aircraft. The only general guideline offered by the FAA states: "Sufficient rescue and fire fighting personnel are available during all air carrier operations to operate vehicles, meet the response times, and meet the minimum agent discharge rates required by this part" (FAA Regulations Part 139.319, 1989).

The Fire Chief's Handbook begins by reiterating FAA regulation when addressing staffing issues. "The FAA requires enough on-duty personnel to get the required number of vehicles to an aircraft accident scene and discharge the required flow of extinguishing agent. This can usually be accomplished with one driver operating the top turret nozzle" (Bachtler and Brennan, 1995, p773). They follow this by adding:

> At least two fire personnel should be assigned to each ARFF apparatus to assist with radio operation, watch for aircraft, help guide the vehicle onto the accident scene, operate multiple turrets, as well get out of the apparatus and do something. The extra person on each apparatus can assist with evacuation, access, rescue, treatment, aircraft stabilization, handline and interior fire attack operations, and setting up the Incident Command System (Bachtler and Brennan, 1995, p773).

The Fire Chief's Handbook goes on to relate that once the large bulk of fire has been knocked down by roof turrets, handlines should be deployed to extinguish small fires, protect escape paths for occupants, and attack interior fires. ARFF apparatus drivers should remain at the vehicle ready to use roof turrets to attack any re-ignition and protect firefighters (Bachtler and Brennan, 1995). The NFPA has some similar dialog regarding turret/handline tactics:

> Fire prevention/control during evacuation should require strategic positioning of ARFF vehicles and applying foam from turrets to establish a blanket covering the Practical Critical Fire Area (PCA). During this operation, emphasis should be placed on maintaining safe egress paths and eliminating the threat of fire extension into the fuselage. Foam handlines should then be employed to protect evacuees and ARFF personnel, extinguish spot fires, and maintain the integrity of

> the foam blanket. After initial knockdown of the heat and flame, use of handlines to maintain control of evacuation areas can be the key to a successful rescue operation. Ground ladders might be needed to assist occupants who have exited onto wing surfaces and those attempting to exit from openings where evacuation slides are unusable. It is important that assistance be given to evacuees using ladders to ensure that they safely complete their exit and that any one ladder does not become overloaded. (NFPA 402, 1996, p 402-18).

Once again, while not addressed as specific staffing guidelines, these workload requirements can be utilized to determine appropriate staffing needs.

The NFPA also provides some broad input as to the importance and staffing of ARFF apparatus. The importance of interior fire fighting is also addressed:

> Providing protection for the occupants of an aircraft takes precedence over all other operations. Fire control is frequently an essential condition to ensure such survival. The objectives of the airport fire department should be to respond to any aircraft emergency in the minimum possible time and employ rescue and fire fighting techniques effectively. These objectives can be accomplished when properly trained personnel work together as a team (NFPA 402, 1996, p 402-4). During flight operations, sufficient trained personnel shall be readily available to staff the rescue and fire fighting vehicles and to perform fire fighting operations. These trained personnel shall be deployed in a way that ensures that minimum response times can be achieved and that continuous agent application at the

> appropriate rate can be fully maintained. Responding units shall include personnel equipped for cabin interior fire fighting (NFPA 403, 1993, p 403-7). Immediately following the self-evacuation phase of an aircraft accident, a search of the fuselage interior and physical rescue of surviving occupants is crucial. Search and rescue teams should wear full protective clothing and positive pressure self contained breathing apparatus (SCBA). They should also be equipped with charged hoselines for their protection and extinguishment of any fire that might have entered the fuselage. A THOROUGH SEARCH OF THE FUSELAGE INTERIOR AT THIS TIME IS EXTREEMLY IMPORTANT. PERSONS, PARTICULARLY INFANTS, CAN BE EASILY OVERLOOKED OR HIDDEN BY DEBRIS (NFPA 402, 1996, p 402-19). One rescue team method consists of four ARFF personnel equipped with full protective clothing to include SCBA. Two of the personnel are handline operators and precede the other two, who are equipped with appropriate hand-held tools needed for forcible entry, extrication, and making access to hidden fuselage fires behind panels, floors, and compartments. A procedure preferred by some fire departments is to provide an additional handline operator, similarly equipped, operating behind the rescue team with a spray stream, as their protection throughout the entire operation (NFPA 402, 1996, p 402-20).

While the NFPA stresses the importance of interior fire fighting capability, it places the primary responsibility of passenger safety to include the decision of when and how to evacuate

an aircraft involved in fire on the fight crew (although a provision is included that in the event the flight crew becomes incapacitated or evacuation does not begin immediately, ARFF personnel should begin evacuation procedures) (NFPA 402, 1996). Mr. Larry Roman of the National Transportation Safety Board (NTSB) while in agreement regarding interior fire fighting, expressed concern as to the practice of the flight crew determining overall evacuation practices. In a telephone interview conducted by Mr. Charles Brush, Mr. Roman related that while he has not seen any extinguishment of interior aircraft fires that could have had impact upon occupant survivability, he questions the validity on staffing to fight exterior fires only. He also questions the practice of relying upon the evacuation of an aircraft to be accomplished by the flight crew and/or self evacuation alone. In 1984 the NTSB recommended that all ARFF apparatus be staffed with a minimum of two fire fighters. He related the FAA did not concur with this recommendation (Brush, 1997).

The seriousness of interior fire fighting is also stressed by Mr. Thomas J. Phillips, Chairman of the Airline Pilots Association Accident Survival committee. In a letter dated May, 1994 he wrote:

> ARFF is effective and necessary. ARFF for commuter airports is needed, though it may indeed need some customizing for the particular operations. Review of accident data shows that the survivable accidents that we are concerned about, where we seek to enable survival of those aircraft occupants that survive the initial accident impact, are in the vast majority occurring on the airport. More than 50 percent of the fatalities in survivable accidents are the result of smoke
>
> and fire. It is for this reason that ***rescue*** and fire assistance is so critically needed (Phillips, May 1994).

The “turret only” approach was also addressed by Chief Bernard Brown of the United Kingdom Civil Aviation Authority. In a 1990 article he writes:

> Over recent years it is probably true to say that airport firemen have become too reliant on their huge turrets that give mass application of foam. There are a number of dangers from this:
>
> (i) Passengers escaping from the aircraft can be subjected to a jet of foam which is at over 200 pounds per square inch pressure when it leaves the turret, is being delivered at a rate of 1500 gallons per minute, and which by quantity of 15,000 pounds per minute. It will be readily appreciated that this amount is enough to blast passengers off wings and to damage or misplace slides.
>
> (ii) The other important factor is that as soon as the external fire has been suppressed, some of the water carried on the vehicle will be required inside the aircraft whilst searching and rescue work progressing. Misuse of turrets may mean that insufficient water is left to deal with any internal fire (Brown, 1990).

In a position paper, the International Association of Fire Fighters (IAFF) along with the endorsement of the International Association of Fire Chiefs (IAFC) and Airline Pilots Association, stresses current staffing regulations are not adequate.

> The FAA does not direct fire fighters to rescue the crew and passengers of a crashed and burning aircraft but states only that they provide an escape path, according to the Transportation Trades Department testimony to Congress. The responsibility for evacuation is left to the flight crew.

> At a time when the FAA and aircraft manufacturers are cooperating to make passengers' chance of survival greater than ever, it makes little sense not to invest the time and resources necessary to meet the challenges of responding to aircraft emergencies.
>
> We believe that FAA Regulations Part 139 is inadequate to protect the traveling public. It should be the purpose of Part 139 to save the lives of all survivors. The regulations shortcomings include staffing levels, the amount of equipment available, response time, and emergency medical response. The FAA's rules should be more specific about actions to be taken to ensure the escape of passengers from a burning aircraft. Because the FAA gave the responsibility to the carriers, they have moved toward having one fire fighter per vehicle, whose sole responsibility under the rules is to spread extinguishing agents on the exterior of the aircraft to provide one path through burning fuel in order for passengers and crew to escape. If you add that [evacuation] responsibility to the fire fighters, you would have to add equipment and staff. We don't have that now. The current fire fighting establishment cannot handle both rescue/evacuation and fire suppression (IAFF,1998).

To this point, the focus has been on the control of fire, and the rescue of occupants from the hazardous area. Another area which is equally important is the emergency medical treatment needed by many of the survivors. Jems Communication, a leading Emergency Medical Services (EMS) publication group, published a study entitled "A Comparative Analysis of the Emergency Medical Service and Rescue Response to Eight Airliner Crashes in the United States, 1987-1991." This article

analyzes, as stated the response and outcome of eight significant airliner incidents. Of the eight incidents, the crash of Flight 232 bound from Denver to Chicago had the most favorable results. A catastrophic mechanical failure occurred while over northwest Iowa.

> The aircraft was diverted to Sioux Gateway Airport, and the ARFF and local fire and EMS resources were activated. Based on additional information that the aircraft may not make it to the airport, the status of the incident was upgraded to a Alert III (actual crash) about 30 minutes prior to the crash. Thus, many additional emergency resources were activated to be or headed to the airport. The DC-10 aircraft crash landed with a total of 296 passengers and crew on board. One hundred eighty-five passenger/crew survived, and 111 died. Thirteen people were not injured. The excellent response was a major factor in the remarkable survival rate (Anderson, 1995, p 145).

PROCEDURES

The research procedures used in this report included a literature review and a survey instrument sent to a sampling of airport fire departments across the country.

The literature review consisted of gathering data from all relevant information available at the NETC (LRC) and the resource library located at the PAFB Fire Department.

The survey instrument was constructed in such a manner to provide data towards the posed research questions. A pilot test of the survey instrument was performed on members of the PAFB Fire Department. This was done to ensure the survey instrument was easy to read and understand. After a few minor adjustments, the survey instrument was sent to the target audience.

The survey instrument was administered to executive fire officers located at index "A" through "E" airports across the country. Airport index ratings are established by the FAA and are outlined in FAA Regulation Part 139. Index ratings are determined by the size of aircraft which has five or more daily departures from the airport. Small aircraft such as Piper Cubs, Cessna's, and commuter aircraft would classify an airport as an index "A", while Boeing 747's and the Concorde would require an index "E" rating. It was chosen to include all index airports as to determine weather similar staffing concerns would surface regardless of the airports "size".

One hundred surveys were distributed (twenty to each index) with 61 returned for a 61 percent response. As this is a relatively small sampling as compared to all airport fire departments across the United States, the assumption should not be made that it is representative of all airport fire departments. Rather it represents an acquired sampling of a small target audience.

The questionnaire examined ten questions regarding staffing of ARFF apparatus. The first question asked for the index rating of their respective airport. The next question asked whether their fire department had a structural commitment in addition to their ARFF duties. If the respondent indicated they did have a structural response, question three asked if they practiced "cross-staffing" between their ARFF and structural apparatus. Respondents went on to answer several questions regarding the hoselines carried and utilized on their ARFF apparatus. Question six asked the respondent to indicate the number of personnel who would respond to an aircraft emergency. The next question asked if they felt if this number of personnel was adequate to conduct both suppression and

rescue duties simultaneously. Question eight asked the respondent to list the guidelines utilized in determining their respective staffing levels. The last two questions asked the respondent if they felt the FAA and NFPA should address staffing in their respective publications (Appendix A).

Project Limitations

In order to complete the research project in a timely manner a relatively small target audience was chosen for the survey instrument. While painstaking measures were taken to determine the audience that would offer the most experience and expertise, only a fraction of airports across the country were surveyed. It was also assumed the respondents were knowledgeable of their respective organizations and would answer the questionnaire honestly.

Limiting factors of the survey were the small population served and the ability to determine whether this small population was representative of all airport fire departments across the country.

Definitions

Aircraft Accident - An occurrence during the operation of an aircraft in which any person involved suffers death or serious injury or in which the aircraft receives substantial damage (NFPA 402, 1996).

Airport - an area of land or other hard surface, excluding water, used for the landing and takeoff of aircraft and includes buildings and facilities (FAA, 1993).

Alert II - a significant problem with an aircraft in-flight which could lead to a aircraft accident. This is also known as an "in-flight emergency".

Alert III - a confirmed aircraft accident.

ARFF - Aircraft Rescue and Fire Fighting - the fire fighting action taken to prevent, control, or extinguish fire involved or adjacent to an aircraft for the purpose of maintaining maximum escape routes for occupants using normal and emergency escape routes for egress (NFPA 402, 1996).

Announced Emergency - when ARFF personnel have pre-warning of a possible aircraft accident. This is usually accomplished when the pilot of an aircraft declares an in-flight emergency to the air traffic controller. ARFF apparatus will proceed to pre-determined standby locations to wait for the emergency aircraft to arrive.

Critical Response and Fire Fighting Access Area - the rectangular area surrounding any runway within which most aircraft accidents occur on airports. Its width extends 500 ft. from each side of the runway centerline, and its length is 300 ft. beyond each runway end (NFPA 402, 1996).

Index - a classification which is required by the FAA of all certified airports. The index is determined by the length of the largest aircraft which has five or more average daily departures (FAA, 1993).

Index A - aircraft less than 90 feet in length (FAA, 1993).

Index B - aircraft at least 90 feet in length but less than 126 feet in length (FAA, 1993).

Index C - aircraft at least 126 feet in length but less than 159 feet in length (FAA, 1993).

Index D - aircraft at least 159 feet in length but less than 200 feet in length (FAA, 1993).

Index E - aircraft at least 200 feet in length (FAA, 1993).

Practical Critical Fire Area (PCA) - This area is two-thirds of the Theoretical Critical Fire Area (TCA). (See also Theoretical Critical Fire Area) (NFPA 402, 1996).

Rescue - removal or assistance in the evacuation of occupants of an aircraft involved in an accident/incident or those persons exposed to such accident/incident (NFPA 402, 1996).

Rescue Path - a fire-free path from an aircraft accident site to a safe area. This path, normally selected by evacuees, must be maintained by fire fighters during the evacuation process (NFPA 402, 1996). This is also known as the "escape path".

Runway - a defined rectangular area on a land airport prepared for the landing and taking off of aircraft along its length (NFPA 402, 1996).

Theoretical Critical Fire Area (TCA) - a rectangle, the longitudinal dimension of which is the overall length of the aircraft, and the width includes the fuselage and extends beyond it by a predetermined set distance that is dependent on the overall width. Therefore, the

aircraft length multiplied by the calculated width equals the size of the TCA (NFPA 402, 1996).

Unannounced Emergency - when ARFF personnel have no pre-warning of an aircraft accident. This usually occurs while an aircraft is taking off or landing. ARFF apparatus will normally be responding from the airport fire station(s).

RESULTS

The results of this research project were gathered from two areas: a literature review and a survey instrument. The goal in each area was to collect data on staffing of ARFF apparatus.

Research Question 1

Are there nationally recognized standards which assist in staffing decisions of ARFF apparatus?

While the writer was only able to locate one standard which included definitive staffing recommendations and/or guidelines several contributions were found that gave some broad suggestions.

1. Federal Aviation Administration (FAA) Regulation Part 139 Certifications and Operations: Land Airports Serving Certain Air Carriers.

While this standard does not include specific staffing requirements, it does indicate the number of vehicles needed and amount of fire fighting agent required based on the size of the aircraft.

Forty percent of all survey respondents indicated they utilized FAA Regulation Part 139 as a guideline in determining their ARFF apparatus staffing.

2. NFPA 403, *Aircraft Rescue and Fire Fighting Services at Airports*.

"This standard contains the minimum requirements for aircraft rescue and fire fighting services at airports" (NFPA, 1993, p. 4).

Like the FAA standard mentioned above, this standard does not address specific staffing numbers, but does recommend minimum fire fighting agents based on the aircraft size. Additionally, the standard makes several subjective statements such as:

> During flight operations, sufficient trained personnel shall be readily available to staff the rescue and fire fighting vehicles and to perform fire fighting and rescue operations. These trained personnel shall be deployed in a way that minimum response times can be achieved and that continuous agent application at the appropriate rate can be fully maintained. Responding units shall include personnel trained and equipped for cabin interior fire fighting (NFPA, 1993, p.7).

Three percent of all respondents indicated they utilized NFPA 403 as a guideline when determining ARFF staffing.

3. Department of Defense (DOD) Instruction, *Fire and Emergency Services Program.*

"This Instruction applies to the Office of the Secretary of Defense, the Military Departments, and those Defense Agencies having responsibility for maintaining organized fire and emergency services" (DOD, 1994, p. 1).

This instruction requires all required ARFF apparatus to be staffed with a minimum of three personnel. The minimum number of ARFF apparatus will be determined according to NFPA 403 fire fighting agent recommendations.

Seven percent of all respondents indicated they utilized this standard when determining their staffing requirements.

Research Question 2

What are the trends among airport fire departments regarding the staffing of ARFF apparatus?

The survey instrument was used in order to gather data regarding staffing of ARFF apparatus.

The data collected was categorized into two groups. The first statistics are all respondents while the second set of statistics are the group broken down by index ratings.

On average, there were six personnel responding on Alert II or Alert III first alarm assignments of all those surveyed. This was broken down by index ratings as follows (all figures are averaged). (See Figure 1)

Index A: Two personnel

Index B: Four personnel

Index C: Five personnel

Index D: Nine personnel

Index E: Thirteen personnel

(Figure 1)

Research Question 3

Are airport fire departments staffed in such a manner as to efficiently deploy hoselines during an aircraft incident?

Sixty-one percent of all respondents indicated they utilize 1 ¾" handlines during an aircraft incident.

International Fire Service Training Association (IFSTA) *Essentials of Fire Fighting* recommends at least two personnel at the nozzle with another to assist feeding hose to the interior crew (IFSTA, 1994, p.407). This would be in addition to the driver operator assigned to each required ARFF apparatus for a total of three on the handline. The following results were tabulated based on the average index staffing as related in question two. Also included in the determination is the minimum required ARFF apparatus as determined by the FAA. The adjusted staffing is the total staffing minus the drivers needed for the required ARFF apparatus. (See Figure 2)

Index	Total Staffing	# of ARFF Apparatus	Adjusted Staffing	# of hoselines allowed
A	2	1	1	0
B	4	1	3	1
C	5	2	3	1
D	9	3	6	2
E	13	3	10	3

(Figure 2)

In addition, it was also found that thirteen percent of the respondents indicated their first hoseline deployed in an actual aircraft fire is the booster reel. They went on to indicated this is not the hoseline of their choice, but limited staffing dictates this is the only one they can manage with available resources.

Research Question4

Do airport executive fire officers feel they are adequately staffed to effectively mitigate an aircraft accident?

As a whole, seventy-five percent of all respondents did not feel they were adequately staffed to effectively mitigate an aircraft accident. This was broken down by index as follows (all percentages indicate those who felt they were not adequately staffed). (See Figure 3)

Index A: Sixty-three percent

Index B: Seventy-three percent

Index C: Eighty-two percent

Index D: Eighty-six percent

Index E: Fifty percent

(Figure 3)

Research Question 5

Would airport executive fire officers be in favor of nationally recognized staffing recommendations and/or requirements?

Eighty-two percent of all those surveyed indicated they would be in favor of FAA staffing *requirements.* This was followed by eighty-five percent who would be in favor of NFPA staffing *recommendations*. Broken down by index, the results were as follows (all percentages indicated those who were in favor of standards). (See Figure 4)

	FAA Requirements	NFPA Recommendations
Index A	Fifty percent	Fifty percent
Index B	Eighty-two percent	Eighty-two percent
Index C	Ninety-one percent	Ninety-five percent
Index D	Ninety-three percent	Ninety-three percent
Index E	Eighty-three percent	One hundred percent

(Figure 4)

DISSCUSSION

The literature review and survey instrument which were used for this research project brought forth quite a bit of interesting information from several areas. Answers to the questions on the survey instrument, notes added by many of the respondents, and material reviewed provided insight as to the current staffing of ARFF apparatus. Additionally, feedback was provided as to the plausibility of adopting national requirements and/or recommendations.

The FAA has a regulation requiring sufficient staffing to operate vehicles, meet response times, and minimum agent discharge rates (FAA Regulations Part 139, 1989). In many cases this has equated to an ARFF apparatus driver as the only staffing. Just under half of the respondents indicated they utilize minimum FAA requirements as a staffing guideline, with 25 percent relating this regulation requires a driver only. It would be absurd, if not negligent, to arrive at a structure fire (a driver only) with known occupants inside and direct the pumper's deck gun back and forth across the exterior of the house. Unfortunately, this is what occurs on airfields across the country when FAA regulations are not exceeded.

The *Fire Chief's Handbook* and NFPA both acknowledge the importance of deploying handlines once the large bulk exterior fire has been knocked down by roof turrets. The problem is while they acknowledge the need for handline operation, there are no specific staffing guidelines to accomplish this task. When surveyed, index A airports averaged two personnel on duty. One of these people would be required to operate the ARFF apparatus. This would leave one person which is not sufficient to deploy a handline. Bear in mind index A airports service commuter aircraft with 35 - 40 occupants on board. Likewise, index B and C airports averaged enough personnel to allow only one handline to be deployed. It is widely accepted a backup line of equal size will be pulled any time an attack line is put into operation. Additionally, this does not take into account any other duties which may be required during the emergency such as ladder deployment, crew/occupant extraction, emergency first aid, hazard mitigation, etc.. It was also noted thirteen percent of the respondents indicated they can only utilize the booster reel because of limited personnel. This is a risky endeavor as most booster reels do not supply adequate gallons per minute (GPM) to combat a running fuel or interior working fire.

Index E airports had the most staffing with an average of thirteen personnel. Fifty percent of airport executive fire officers felt this was adequate for their needs. What was found interesting is while index A airports are staffed with only two personnel average, they had the next highest percentage of satisfaction at 37 percent. Interestingly, it was found all of the index A respondents who indicated staffing was sufficient were **not** airport executive *fire* officers. This was found due to the fact while optional, 95 percent of all respondents included their name and titles on the returned surveys. It could be concluded the airport *manager*, knowing the operating costs, was making strictly a business rather than a safety and/or tactical decision. Likewise, index E airports usually enjoy higher revenues

due to the volume of flights handled. For this reason it may not be such a financial burden to staff additional personnel.

Mutual aid was addressed as a way to supplement an aircraft incident response. While the writer concurs mutual aid is a viable resource, it should not be relied upon as an alternative to adequate ARFF staffing. With the survivable atmosphere limited to three minutes or less in an aircraft fire situation, mutual aid resources would arrive too late. This is based on an unannounced emergency situation. If there were enough lead time, as in the Sioux City incident, mutual aid forces would be mobilized prior to the aircraft landing. Likewise, the mutual aid response for an alert II is substantially less than that for an alert III. In the Sioux City incident, an alert III was initiated approximately 30 minutes prior to the actual crash. This is very rare as the writer himself, with approximately fifteen years ARFF experience, has never experienced this occurrence. In hindsight, the decision to upgrade to an alert III probably saved many of the occupants lives as a great deal of resources were mustered and ready when the aircraft actually crashed. Unfortunately, an alert III response cannot be initiated on every in flight emergency. Based on the fact most in flight emergencies land safely, a "boy who cried wolf" syndrome would develop and some mutual aid responders would begin to question the validity of their response. To reiterate, this is not to say mutual aid is not needed. Mutual aid is a valuable tool and should be utilized in any emergency planning.

The majority of all respondents (82 percent) indicated they would like to see staffing requirements built into FAA regulations Part 139 while a slightly higher (85 percent) majority related they would like

to see staffing regulations built into NFPA 403 *Aircraft Rescue and Fire Fighting Services at Airports*. The slightly higher NFPA response was explained by several of the respondents who indicated they would like to see the staffing addressed as an recommendation, yet not be accountable to the recommendation as they would be to a regulation.

RECOMMENDATIONS

As a result of this research project, the writer makes the following recommendations:

1. Recommend staffing requirements be established by the Federal Aviation Administration based on the index of the airport served.

2. Recommend staffing guidelines be established as part of NFPA 403 *Aircraft Rescue and Fire Fighting Services at Airports* based on the airport served by ARFF services.

3. Conduct additional research as to track the progress of implementing staffing guidelines and/or regulations. Specifically, monitor the impact of recommended and/or required staffing in regards to survival rates.

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Appendix A

Staffing Concerns Regarding ARFF Apparatus
Executive Fire Officer Project
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The purpose of this questionnaire is to obtain data as part of a research paper addressing staffing concerns regarding ARFF apparatus. This research paper is a project for the Executive Fire Officer Program of the National Fire Academy.

Please take a few moments to answer the following questions. Questionnaires should be returned by **Friday, October 2nd, 1998.** A self-addressed stamped envelope is enclosed for your convenience.

Your assistance is greatly appreciated!!

1. What is the index rating of the airfield your department serves?

Index A_____ Index B_____ Index C_____ Index D_____ Index E_____

2. Does your department have a structural commitment in addition to ARFF duties?

yes_____ no_____

3. If you answered "yes" to the above question, do you cross-staff between your ARFF and structural apparatus?

yes_____ no_____ N/A_____

4. What size preconnected handlines are your ARFF apparatus equipped with? (check all that apply)

Booster Reel_____ 1 ½"_____ 1 ¾"_____ 2"_____ 2 ½"_____

5. Of the above-preconnected handlines, which would be first deployed in an actual aircraft fire incident according to your department SOP's?

_____

6. How many personnel respond on an Alert II or Alert III first alarm assignment? (Do not count personnel who must cross-staff ARFF apparatus from structural apparatus.)

_____

7. Do you feel your department has adequate first alarm staffing to effectively conduct both suppression and rescue duties should an actual incident occur on the airfield? **Note: First alarm implies only the staffed ARFF apparatus. Do not take into consideration any cross staffing or back-up (second due, mutual aid etc.) companies.

yes_____ no_____

8. What guideline(s) do you utilize to determine the amount of personnel assigned to ARFF apparatus? Please be specific.

_____

_____

_____

9. Do you feel the Federal Aviation Administration (FAA) should include a staffing requirement for ARFF apparatus as part of FAA Regulations Part 139? This would be in addition to the fire fighting agent requirements already established.

yes_____ no_____

10. Do you feel the National Fire Protection Association (NFPA) should include a minimum staffing recommendation as part of NFPA 403 Aircraft Rescue and Fire Fighting Services at Airports?

yes_____ no_____

Please attach any support material you feel may be helpful on this topic

Name (Optional)_____

Department, Address and Phone Number (Optional) _____

_____

_____

Would you like a copy of the survey results?

yes_____ no_____